Spatial and Diel Variability in Photosynthetic and Photoprotective Pigments in Shallow Benthic Communities

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LONG-TERM GOALS

We expect considerable spatial and temporal variability in optical properties of shallow benthic and planktonic plant communities. Our long-term goal is to test the hypothesis that the diel component of this variability is predictable and can be separated from the "noise" of other types of variability, and used to characterize and evaluate the community.

OBJECTIVES

Our major objective is to determine the spatial and temporal variability, particularly diel variability, in photosynthetic and photoprotective pigments and the fluorescence spectra of photosynthetic organisms found in different types of shallow marine benthic communities and the associated water column.

APPROACH

We will collect sediment and water samples over 24 hour cycles in several types of environments, including carbonate (Lee Stocking Island, Bahamas) and silicate sands (Monterey Bay, California), in the vicinity of coral reefs and seagrass beds. Photosynthetic and photoprotective pigments will be quantified in these samples using High Performance Liquid Chromatography. Changes in pigments over diel cycles will be related to field measurements of absorbance and fluorescence. Drs. Brand and Stephens are the key individuals participating in this part of the CoBOP program.

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WORK COMPLETED

The first year of this project has been devoted to the planning of field operations and modification of our HPLC system which was set up for analysis of phytoplankon samples. It was necessary to change columns and solvent gradiens in order to optimize pigment separations because of the much larger number of pigments and pigment breakdown products present in sediments. This new set-up has been tested, first with unialgal cultures, then mixtures of cultures including the major taxonomic groups of microalgae, and finally with locally collected sediment samples.

Measurements of spectral fluorescence have been made on samples of sand and rubble collected from Lee Stocking Island by Dr. Fred Dobbs. Chlorophyll a was also measured in acetone extracts. These preliminary studies were conducted to gain some insight into the quantity (i.e. core diameter) of sediment that will be needed for analysis when actual field studies begin in the Spring of 1998.

Diel variations in pigment ratios have been measured in the laboratory under varying light regimes using unialgal cultures.

RESULTS

The HPLC columns and solvent gradients are producing good photosynthetic and photoprotectant pigment separations for sediment samples.

Fluorescence in several wavebands was observed when carbonate sediment and rubble with attached flora (Lee Stocking Island) was stimulated with light at 488 nm. A broad band of fluorescence was measured between 530-580 nm, with sharper peaks at about 630, 690, and 730 nm. There was no measurable 488 nm stimulated fluorescence by these materials after acetone extraction and drying. The amount of chlorophyll *a* extracted in acetone from the sand sample was 1.23ug/g sediment. These data indicate that there is a substantial amount of fluorescent pigment in the sediment.

Diel variations in pigment ratios of unialgal cultures have been documented in our laboratory studies

IMPACT/APPLICATIONS

The results of our field studies will be used by other members of the CoBOP team and other research and development programs within DOD concerned with remote sensing and underwater imaging, especially for optically-shallow water environments. Further, measurements of spatial and temporal variations in plant pigments from both sediments and the water column will be used to define relationships between measured benthic and water column optical properties and to understand how optical properties are affected by biological,chemical and physical processes.

TRANSITIONS

These data are not yet being used by others because they are preliminary in nature and the actual field studies for the CoBOP group have not yet commenced.

RELATED PROJECTS

We are funded by EPA to study the effects of UV-B on marine phytoplankton. One aspect of this program is to determine the effects of various levels of exposure to UV-B on phytoplankton pigments and pigment ratios.

REFERENCES

none